

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: K. TAKEUCHI, et al.
Serial No.: 10/591,696
Filed: July 16, 2007
For: PREPREG, METAL-CLAD LAMINATE AND PRINTED CIRCUIT BOARD USING SAME
Group AU: 1794
Examiner: Camie S. Thompson
Confirm. No: 3031

REQUEST FOR RECONSIDERATION**Mail Stop: AMEND – FEE**

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

April 15, 2009

Sir:

In response to the Office Action mailed October 15, 2008, Applicants respectfully request reconsideration of each of the prior art rejection and of the obviousness-type double patenting rejection set forth therein. As will be shown in the following, it is respectfully submitted that the teachings of U.S. Patent No. 7,138,174 to Takeuchi, et al., and the subject matter claimed in No. 7,138,174, would have neither disclosed nor would have suggested the presently claimed subject matter, including, inter alia, wherein the polyamideimide resin has a structure that includes a structure represented by general formula (1), which includes two cyclohexyl groups connected via a $-\text{CH}_2-$ group with one carbon atom.

In particular, Applicants respectfully submit that all of the claims presented for consideration by the Examiner patentably distinguish over the teachings of the reference applied by the Examiner in rejecting claims in the Office Action mailed October 15, 2008, that is, the teachings of the U.S. patent to Takeuchi, et al., No. 7,138,174, under the provisions of 35 USC 102 and 35 USC 103.

It is respectfully submitted that the reference as applied by the Examiner would have neither disclosed nor would have suggested such a prepreg, or such a metal foil-clad laminate using such prepreg, or such printed circuit board using such metal foil-clad laminate, as in the present claims, wherein the prepreg is obtained by impregnating a resin composition including a polyamideimide resin and thermosetting resin as in the present claims, with the polyamideimide resin having a structure that includes a structure represented by general formula (1), which includes two cyclohexyl groups connected via a $-\text{CH}_2-$ group, such resin composition being impregnated into a fiber base material with a thickness of 5-50 μm . See claim 1; note also claims 15 and 16.

Furthermore, it is respectfully submitted that the teachings of this applied reference would have neither disclosed nor would have suggested such a prepreg as in the present claims, having features as discussed previously in connection with claim 1, and including, additionally, wherein the resin with an imide structure, which is a polyamideimide resin, has a siloxane structure (see claim 3); and/or further definition of the polyamideimide resin as in claims 6 and 8; and/or wherein the thermosetting resin is an epoxy resin, as in claim 9, having two or more glycidyl groups (see claim 10); and/or wherein the composition further includes a phosphorus-containing compound, in amounts thereof, as in claim 11, or further contains a hindered phenol-based or organic sulfur compound-based antioxidant as in claim 12, more specifically, is one or more types of the antioxidant compounds as set forth in claim 13; and/or combustion distance of the prepreg as in claim 14; and/or further definition of the polyamideimide resin as in claim 17; and/or further definition of the fiber base material as in claim 18.

The present invention is directed to a prepreg, and to a metal foil-clad laminate and printed circuit board employing such prepreg.

Laminates for printed circuit boards are formed by stacking a prescribed number of prepregs that include an electrical insulating resin composition, and subjecting the prepregs to heat and pressure for integration. Such laminates are provided with a metal foil such as a copper foil on one or both surfaces of the laminate, with the foils being patterned for forming electrical circuitry.

Recently, with the trend toward miniaturization and high-densification of the printed circuit boards, and with newly proposed surface mounting methods, heat resistance of the insulating resin has become more important, with higher heat resistance being necessary. In addition, halogen-free materials are also necessary, precluding use of bromine-based flame retardants.

In addition, because it becomes necessary to repair the printed circuit boards by removing mounted chips and replacement thereof, each procedure requiring heat treatments, cycling heat shock-resistant properties at high temperatures have also become necessary.

Thus, it is desired to provide prepregs, for use in printed circuit boards, exhibiting heat shock resistance, reflow resistance and crack resistance, and improved microwiring formation properties. In addition, it is also necessary to provide printed wiring boards having dimensional stability and the ability to be bent and housed at high density in electronic device packages, the prepreg thereof having adhesion with metal foils and fiber base materials. Note, in particular, paragraph [0008] on page 3 of Applicants' specification.

Against this background, Applicants provide a prepreg having excellent heat resistance and pliability. Applicants have found that by utilizing a resin composition,

to impregnate a fiber base material, which includes a thermosetting resin and a polyamideimide resin having a structure that includes a structure of general formula (1), which includes two cyclohexyl groups coupled via a $-\text{CH}_2-$ group, the fiber base material having a thickness of 5-50 μm , heat resistance and flexibility as desired can be achieved; in particular, through use of such impregnating resin composition, together with a fiber base material with a thickness of 5-50 μm , a prepreg having good flexibility with good heat resistance including thermal cycling resistance, and other favorable properties, is achieved.

Takeuchi, et al. discloses a prepreg having adhesion properties and heat resistance, the prepreg comprising a fiber base material impregnated with a resin composition which comprises a polyamideimide resin and a thermosetting resin as essential components. See column 2, lines 59-62. Note also column 3, lines 20-25, disclosing use of a siloxane-modified polyamideimide resin. Note also disclosure of the fiber base material, in the paragraph bridging columns 9 and 10 of this patent, including disclosure that glass cloth is preferred, more preferably woven fabric comprised of glass fiber, with a thickness preferably being 10-200 μm . Note also column 10, lines 50-59, disclosing use of copper and aluminum foils. As applied by the Examiner, note column 3, line 26, to column 5, line 3, especially column 4, line 25, of this patent, where Takeuchi, et al. discloses use of a siloxane-modified polyamide-imide resin, obtained by reacting a diimidedicarboxylic acid with an aromatic isocyanate, the acid including, inter alia, structure of two aromatic (benzene) rings connected via a $-\text{CH}_2-$ group.

It is emphasized that Takeuchi, et al. discloses that X of the diimidedicarboxylic acid in column 3, line 60 has one or two aromatic (benzene) rings. It is respectfully submitted that this chemical structure of X in column 4, lines

10-40, of Takeuchi, et al., including the X group at column 4, line 25, is an entirely different chemical structure from that of general formula (1) as in the present claims, which includes two cyclohexyl groups, and would have neither disclosed nor would have suggested the presently claimed subject matter, including wherein the resin has a structure that includes a structure represented by the general formula (1) of claim 1, having two cyclohexyl groups connected via a $-CH_2-$ group.

Furthermore, it is respectfully submitted that Takeuchi, et al. discloses prepregs with substrate material thickness overlapping that in the present claims. It is respectfully submitted that Takeuchi, et al. would have neither taught nor would have suggested the materials as in the present claims, including wherein the resin has a structure that includes a structure represented by the general formula (1) in claim 1, and wherein such material has a thickness of 5-50 μ m, achieving with such thickness a flexibility of the prepreg as achieved by the material of the present claims.

The chemical structure set forth by the Examiner in line 4 from the bottom on page 3 of the Office Action mailed October 15, 2008, is noted. As can be appreciated by one of ordinary skill in the art, the structure set forth therein has two aromatic (benzene) rings. In fact, noting the various groups set forth in column 4, lines 10-40, of Takeuchi, et al., each has at least one aromatic (benzene) ring. It is respectfully submitted that such structures for X at column 4, lines 10-40, of Takeuchi, et al., including the chemical structure for X at column 4, line 25, and set forth on page 3 of the Office Action mailed October 15, 2008, having aromatic structure, would have neither taught nor would have suggested the presently claimed subject matter, including the general formula (1) having two cyclohexyl rings, and advantages of the present invention.

The obviousness-type double patenting rejection set forth in Item 12 on page 6 of the Office Action mailed October 15, 2008, is respectfully traversed, in view of the following. In view thereof, it is respectfully submitted that Applicants need not file a Terminal Disclaimer in the above-identified application, for overcoming this obviousness-type double patenting rejection.

Thus, Patent No. 7,138,174 (Takeuchi, et al.) claims a metal-clad laminated sheet. Claim 6 recites that the sheet includes a polyamide-imide resin that is a siloxane-modified polyamide-imide resin obtained by reacting, inter alia, a diimidedicarboxylic acid having a specified chemical formula, which includes X, X being one group selected from a specified listing of groups including the chemical structure set forth in Item 12 on page 6 of the Office Action mailed October 15, 2008. It must be emphasized that this chemical structure for X as relied upon by the Examiner has two aromatic (benzene) rings connected via a $-CH_2-$ group. Such claimed subject matter in No. 7,138,174 would have neither disclosed nor would have suggested the presently claimed subject matter, including, inter alia, wherein the polyamideimide resin has a structure that includes a structure represented by the general formula (1) in claim 1, having two cyclohexyl rings connected via a $-CH_2-$ group.

In addition, it is respectfully submitted that the teachings of Takeuchi, et al., or the subject matter claimed in Takeuchi, et al., would have neither taught nor would have suggested such subject matter claimed in the above-identified application, including the resin having the general formula (1) in claim 1 having two cyclohexyl groups connected via a $-CH_2-$ group, and with a thickness of the fiber base material as in claim 1, and with additional features as in the dependent claims, as discussed previously.

April 15, 2009

The indicated allowability of the subject matter of claims 8, 12 and 13, set forth in Item 13 on pages 6 and 7 of the Office Action mailed October 15, 2008, is noted with thanks. As can be appreciated, as all of the presently submitted claims, including independent claim 1, should be allowed, Applicants need not set forth the subject matter of claims 8, 12 and 13 in independent form, in order for these claims to be allowed.

Contentions by the Examiner in Item 14 on page 7 of the Office Action mailed October 15, 2008, are noted. While the Examiner relies on the aromatic ring-containing compounds in column 4 of Takeuchi, et al. as describing the general formula (1) of claim 1, as shown in the foregoing, such aromatic ring-containing structure in Takeuchi, et al. would not have disclosed, nor would have suggested, the general formula (1) of claim 1, including the cyclohexyl rings connected via a $\text{-CH}_2\text{-}$ group.

In view of the foregoing comments, reconsideration and allowance of all claims presently pending in the above-identified application are respectfully requested.

To the extent necessary, Applicants hereby petition for an extension of time under 37 CFR 1.136. Kindly charge any shortage of fees due in connection with the

April 15, 2009

filing of this paper, including any extension of time fees, to the Deposit Account of Antonelli, Terry, Stout & Kraus, LLP, Account No. 01-2135 (case 1303.46565X00), and please credit any overpayments to such Deposit Account.

Respectfully submitted,

ANTONELLI, TERRY, STOUT & KRAUS, LLP

/William I. Solomon/

William I. Solomon

Registration No. 28,565

WIS/slk
1300 N. 17th Street, Suite 1800
Arlington, Virginia 22209
Tel: 703-312-6600
Fax: 703-312-6666